THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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SEEING BY ELECTRICITY.

SOME excitement has been created in the electrical world by the report that a sealed packet, containing the account of an invention, has been deposited by the inventor of the Bell telephone. The report states that the invention is one for "seeing by electric telegraphy." What the nature of the invention is, remains, as yet, a mystery; but, in the mean time, attempts are being made to snatch the credit of the invention or discovery from the possible true inventor's hands. A letter has recently been circulated by some well-known scientific gentlemen, to the effect that whatever may be the means by which Professor Bell effects the object he is supposed to have in view, that object has already been practically worked out. The argument contained in the letter in question seems to us to be of the flimsiest possible description; and to say that to the discoverer of the effect of light upon the electrical resistance of selenium really belongs the credit of having solved the question of seeing by electricity, is equivalent to assigning to Faraday the credit of having invented the telephone. The idea put forward as furnishing a solution of the problem is as far from the practical solution as can well be imagined, and the attempt to claim credit at the expense of future real inventors, is, in our opinion, decidedly contemptible, and we must express our surprise at the spirit which could have prompted such an act.

As regards the general question of seeing by electricity, the principles involved are somewhat different from those which have entered into other electro-telegraphic problems; the element of *time*, which plays such an important part in all telegraphic inventions hitherto brought out, is almost wholly absent when the question of sight is involved. In the transmission of sound, or of telegraphic signals by electricity, we have to cause a succession of signals to follow one after the other, and hence it follows that a single telegraphic wire is able to effect all that is required. In the case of *seeing*, in order to enable the form and colour of an object to be rendered evident to the senses, it is necessary that a series of impressions, infinite in variety, be produced upon the retina in an almost immeasurably short space of time, and, practically, all at the same instant; we must have, in fact, an infinite series of waves transmitted at the same, or nearly the same, moment. To do this through a single wire by electrical means is a difficult problem; but that it will eventually be done by means of a single wire, is, we think, an undoubted fact. How it is to be done is another question; but we feel certain that no arrangement involving a multiplicity of wires will ever enable success in the direction aimed at to be attained. It is not because a multiplicity of wires is objectionable for practical telegraphic purposes that we say this; but, because, almost without exception, all complete solutions of problems, like that of the telephone, for example, have been most completely and thoroughly effected by the simplest means.

ON MAGNETIC CIRCUITS IN DYNAMO AND MAGNETO-ELECTRIC MACHINES.*

By LORD ELPHINSTONE and CHARLES W. VINCENT, F.R.S.E., F.C.S., F.I.C.
Communicated by Professor G. G. STOKES, Sec. R.S.

(Continued from page 136.)

IN the course of these experiments it was remarked, that the longer the period the soft iron remained in close magnetic circuit the more magnetically ductile did its molecules appear to become. An electro-magnet, which had been for a few days in closed circuit, could, after rupture of the circuit, be made to sustain weights in a fresh closed circuit at much shorter intervals of time than if it was magnetised, after being for some time with its poles uncovered. The direction of the battery current with reference to the residual magnetism of the electro-magnets appeared to be of no moment. A magnet which had been left for some time with its poles uncovered had less residual magnetism after a momentary current had passed through its helices than another magnet which had been in active closed circuit, even if the battery current had, in the latter case, to overcome a considerable amount of residual magnetism.

We found, moreover, that soft iron magnets retain their residual magnetism longer, and are capable of acquiring increased magnetisation much more rapidly after having been bearing weights (thereby keeping the iron in a state of strain), than if they have been left in their normal condition and without bearing any weight at all.

The conditions under which the closed magnetic circuit retains its force are not yet clearly established.

With the 58 lb. magnet a succession of gentle taps, struck vertically with a wooden mallet upon the centre of the armature, while resting on the magnet in close circuit, in a very few moments completely dissipated the magnetic force, so far as the sustaining power of the magnet was concerned.

Removal of any portion of the weight suspended

* Read before the Royal Society.

to the armature of a magnet hung up in closed circuit likewise tends to dissipate the force of the circuit. For example:—Half an hour after the removal of a weight of 10 lbs., which had been suspended to the armature of a U magnet for twenty-one days, the armature fell off on receiving a slight touch. In another experiment, a U magnet, which was capable of sustaining 7 lbs., and which had actually been suspending 4 lbs., was left for two months with the armature on only, the weight having been removed; at the end of that time a very slight shake was sufficient to cause the armature to fall off. Many other examples might be quoted to show that release from a strain diminishes the magnetic force of the circuit.

In these experiments, in which the closed magnetic circuits had given way, the soft iron had been in a state of strain from which it had been released by the removal of the suspended weights. But when no weights were hung upon the armature, and the iron had never been in a state of magnetic tension, the closed magnetic circuit, so far from diminishing, increased in force. The 58 lb. magnet was excited with a voltaic current so feeble, that although the magnet could be lifted by the armature in closed circuit, yet great care was necessary that the lift should be exactly vertical; and very little force was required to slide the armature off the poles. After the lapse of a month the armature was so firmly held that the utmost exertion of manual force could not stir it by a sliding movement, and the whole magnet could be raised from the ground even if tilted as much as 15° from the perpendicular.

The magnetism of the closed circuit of the 58 lb. magnet disappears after repeated up and down movements of either one or both of its helices, provided the ends of the helix wires are connected together either singly in two separate circuits, or together in one continuous circuit. Every up or down movement of either of the helices produces currents in the wires either for or against magnetisation, which currents apparently so disturb the molecules of the iron that the fixity of their original magnetic direction is lost.

In like manner as the movements of the armature, or the increased or diminished tension of the iron, produce currents of electricity in the helix wires surrounding the magnets: so the movements of the helices produce currents of electricity in the helix wires surrounding the magnets: so the movements of the helices produce currents of electricity which may either magnetise or demagnetise the iron. With the 58 lb. magnet in closed circuit, the two ends of one of the helices being connected to the galvanometer, and the two ends of the other helix being connected with each other, the latter helix is moved towards the armature, a current is produced in the galvanometer helix, which shows a fall of magnetization. On moving the same helix away from the armature, a current is produced in the direction of magnetisation.

In another experiment 30 yards of No. 16 covered copper wire, with its ends connected together, and so coiled that it could be moved freely from pole to pole over the armature, was placed on one limb of the 58 lb. magnet and the closed circuit established. Both helices were then brought into continuous circuit through the galvanometer.

On movement of the coil of wire from south limb to the north limb of the magnet, a current was produced showing an increase of magnetisation. On moving the coil in the opposite direction, *i.e.*, over the north limb pole, and on to the south one, the current is reversed, and is in a direction which would cause demagnetisation.

It appears, therefore, that any interference with the lines of force about a magnetic circuit, means an interference with the magnetic circuit itself, and points to the possibility of building up magnetic force of magnets by the mere movement of wires in these lines of force, though the coils moved need not of necessity be connected with the helices surrounding the magnets.

A NEW ALTERNATING CURRENT DYNAMO-ELECTRIC MACHINE.

A DYNAMO-ELECTRIC machine, involving some novel points, has recently been invented by Mr. J. Rapieff.

Fig. 1.

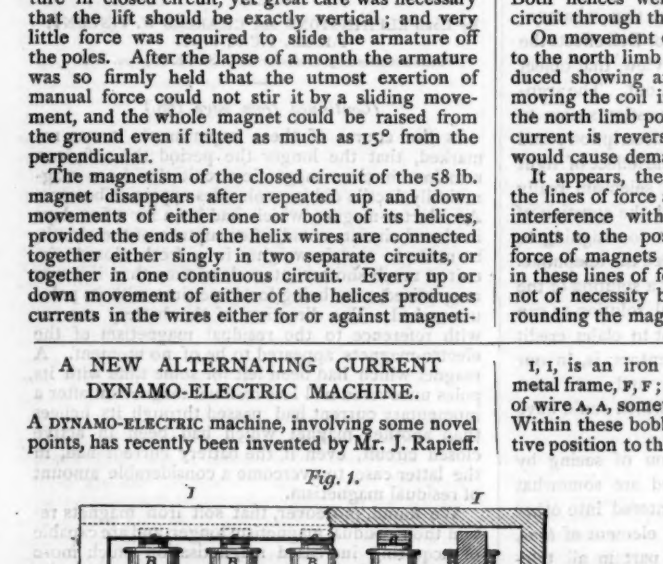
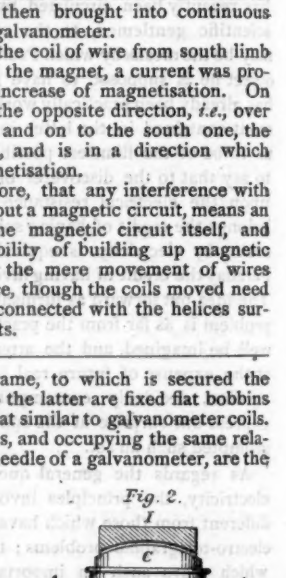


Fig. 2.



The general principle of this machine is shown in side and end elevation by figs. 1 and 2, the figs. being drawn partly in section.

I, I, is an iron frame, to which is secured the metal frame, F, F; to the latter are fixed flat bobbins of wire A, A, somewhat similar to galvanometer coils. Within these bobbins, and occupying the same relative position to the needle of a galvanometer, are the flat bobbins, B, B, which contain soft iron cores, C, C; the latter are secured to an axle, *a*, *a*, by which they can be rotated. The ends of the coils, B, B, are con-

nected to brushes, *b*, *b*, by means of which continuity can be kept up whilst the bobbins rotate. The wires from A, A are connected to terminals, in the ordinary manner. To work the machine, a permanent current is sent through the bobbins, B, B, which latter are kept continually rotating by the axle, *a*, on which is fixed the driving pulley, P. As the bobbins, B, B, and their soft iron cores, C, C, rotate within the bobbins, A, A, alternate currents are induced in the latter each time a half revolution is completed. The strength of these currents is increased by the action of the iron inductive armatures, I, I, which close the magnetic circuit of the core, C, C, each time the two come opposite one another; thus an effect is produced similar to that which would take place if the core, C, C, were alternately magnetised and demagnetised.

A great point in this machine consists in the fact that no commutator with brushes is required, a feature not possessed by other machines.

SOME ELECTRICAL MEASUREMENTS OF ONE OF MR. EDISON'S HORSESHOE LAMPS.

By HENRY MORTON, Ph. D., ALFRED M. MAYER, Ph. D., and B. F. THOMAS, A.M., at the Stevens Institute of Technology.

MUCH has been written and said within the last few months on the subject of Mr. Edison's new horseshoe lamps, and with all the writing and saying there has been wonderfully little produced in the way of precise and reliable statement concerning the simple primary facts, a knowledge of which would give the means of estimating both the scientific and commercial status of this widely discussed invention.

It was, therefore, with great pleasure that the present writers found themselves, through the kindness of the *Scientific American*, placed in possession of one of these horseshoe lamps of recent construction.

To satisfy themselves as to the real facts of the case, they soon made a series of careful measurements and determinations, and as the results of these are likely to interest others, they now put them in print for general benefit.

A further examination of other lamps would have been made at the same time had opportunity offered; but as a communication on this subject addressed to Mr. Edison did not evoke a reply, they are obliged to content themselves with the one lamp as a subject of experiment.

They would, however, here remark, that the behaviour of this lamp, under the tests, and the agreement of its results with information otherwise obtained, convince them that it is at least a fair specimen of the lamps of this form so far produced at Menlo Park.

The first object, on receiving the lamp, was to determine roughly what amount and character of electric current would be needed to operate it efficiently. With this view a number of cells of a small Grove's battery were set up, having each an active zinc surface of twenty square inches and a platinum surface of eighteen square inches.

The lamp being placed in the situation usually occupied by the standard burner in a Sugg's photometer, the battery was, cell by cell, thrown into circuit.

When ten cells had been introduced, the horseshoe showed a dull red, with fifteen cells a bright red, with thirty-four cells the light of 1 candle was given, with forty cells the light of $4\frac{1}{2}$ candles, and with forty-five cells the light of $9\frac{1}{2}$ candles, and with forty-eight cells 16 candles.

Having thus determined what amount of electric current would be required for experiments, arrangements were made to measure accurately the resistance of horseshoe while in actual use and emitting different amounts of light. The resistance of this carbon thread at the ordinary temperature had been already determined as 123 ohms in the usual way, but it was presumed, as had been shown by Matthiessen (*Phil. Mag.*, xvi., 1858, pp. 220, 221), that this resistance would diminish with rise of temperature.

To measure the resistance under these circumstances the apparatus was arranged as follows:—The current from the battery was divided into two branches, which traversed, in opposite directions, the two equal coils of a differential galvanometer. One branch then traversed the lamp, while the other passed through a set of adjustible resistances composed of German-silver wires stretched in the free air of the laboratory, to avoid heating. (Careful tests of these resistances showed that no sensible heating occurred under these circumstances.)

Matters being thus arranged, the resistances were adjusted until the galvanometer showed no deflection when the candle power of the lamp was taken repeatedly in the photometer, and the amount of resistance was noted.

These measurements were several times repeated, shifting the coils of the galvanometer and reversing the direction of the current.

The results so obtained were as follows:—

Resistances.	Condition of Loop.
123 ohms.	Cold.
94 "	Orange light.
83·7 "	$\frac{9}{10}$ candle.
79·8 "	5 "
75 "	18 "

The photometric measurement was in all these cases taken with the carbon loop at right angles to the axis of the photometer, which was, of course, much in favour of the electric lamp. On turning the lamp round so as to bring the carbon loop with its plane parallel with the axis of the photometer, *i.e.*, the edge of the loop turned toward the photometer disc, the light was greatly diminished, so that it was reduced to almost one-third of what it was with the loop sideways to the photometer disc.

Having thus determined the resistance of the lamp when in actual use, it was next desirable to measure the quantity of the current flowing under the same conditions.

To do this the current from fifty cells of battery was passed through a tangent galvanometer as a mere check or indicator of variations, and then through a copper voltameter, *i.e.*, a jar containing solution of cupric sulphates with copper electrodes immersed, and then through the lamp, placed in the photometer.

Under these conditions it was found that during an hour the light gradually varied from about 16 candles at the beginning to about 14 candles at the end, making an average of about 15 candles, measured with side loop of toward disc.

The galvanometer during this time only showed a fall of half a degree in the deflection of the needle.

Carefully drying and weighing the copper electrodes, it was found that one had lost 1·0624 grammes.

Now it is well known that a current of one weber takes up 0·00326 gramme of copper per second, which would make 1·1736 grammes in an hour; therefore the current in the present case must have been on the average $\frac{1·0624}{1·1736} = 0·905$ weber, or a little less than one weber.

Having thus obtained the resistance of the lamp when emitting a light of 15 candles, namely, 76 ohms, and the amount of current passing under the same conditions, namely, 0·905 weber, we have all the experimental data required for the determination of the energy transformed or expended in the lamp, expressed in foot pounds. For this we multiply together the square of the current, the resistance, the constant 0·737335 (which expresses the fraction of a foot pound involved in a current of one weber traversing a resistance of one ohm for one second), and the number of seconds in a minute. Thus, in the present case, we have $0·905^2 = 0·8125$, and $0·8125 \times 76 \times 0·737335 \times 60 = 2753·76$ foot pounds.

Dividing these foot pounds per minute by the number of foot pounds per minute in a horse-power, that is, 33,000, we have 0·08, that is, about eight one-hundredths or one twelfth of a horse-power as the energy expended in each lamp.

It would thus appear that with such lamps as this, one horse-power of energy in the current would operate 12 lamps of the same resistance with an average candle-power of 10 candles each,* or 120 candles in the aggregate.

Assuming that a Siemens or Brush machine were employed to generate the electric current, such a current would be obtained, as has been shown by numerous experiments, with a loss of about 40 per cent. of the mechanical energy applied to the driving pulley of the machine. To operate these 12 lamps, therefore, we should have to apply more than one horse-power to the pulley of the machine, so that when this loss in transformation had been encountered there should be one horse-power of electric energy produced. This would call for 1¾ horse-power applied to the pulley of the dynamo-electric machine by the steam engine.

To produce one horse-power in a steam engine of the best construction about 3 lbs. of coal per hour must be burned, and therefore for 1¾ horse-power 5 lbs. of coal must be burned.

On the other hand 1 lb. of gas coal will produce five cubic feet of gas, and will leave, besides, a large part of its weight in coke, to say nothing of other "residuals," which will represent practically about the difference in value between "steam making" and "gas making coal," so that it will not be unfair to take 5 lbs. of gas coal as the equivalent of 5 lbs. of steam coal.

These 5lbs. of gas coal will then yield 25 cubic feet of gas, which, if burned in five gas burners of the best construction, will give from 20 to 22 candles each, or 100 to 110 candles in the aggregate.

We have, then, the twelve Edison lamps producing 120 candles and the five gas burners producing 100 to 110 candles, with an equivalent expenditure of fuel.

If each apparatus and system could be worked with equal facility and economy, this would, of course, show *something* in favour of the electric light; but when in fact everything in this regard is against the electric light, which demands vastly more machinery, and that of a more delicate kind, requires more skilful management, shows more liability to disarrangement and waste, and presents an utter lack of the storage capacity which secures such a vast efficiency, convenience, and economy in gas, then we see that this relatively trifling economy disappears or ceases to have any controlling importance in the practical relations of the subject.—*Scientific American.*

* The candle power being 15 candles in the best position, and 5 candles at right angles to this, the average or general illuminating power of the lamp is 10 candles.

ON THE MECHANICAL TRANSMISSION OF SOUND BY WIRES, AND ON SIMPLE FORMS OF MICROPHONE RECEIVERS.

By W. J. MILLAR, C.E., Sec. Inst. Engineers and Shipbuilders in Scotland.

THE object of the present paper is the description of a series of experiments made by the author upon the transmission of sounds by wires without the aid of electricity, and also the description of some simple forms of microphone receivers, which the author has from time to time arranged when experimenting upon electric transmission of sound.

The author's attention had for some time been drawn to the consideration of the mechanical transmission of sound through partition-walls between rooms, and it appeared to him that such transmission might be possible, even although the intermediate connection was much extended.

Some experiments were made with wires, which were at first unsuccessful on account of the proximity of the speaker and hearer, and from not having suitable terminations to the line of wire used.

Further experiments, however, showed that, when the ends of the wire were sufficiently far apart, and by using as terminals simple pasteboard discs, or boxes, no difficulty was experienced in transmitting vocal sounds.

Various experiments were afterwards made from time to time. These experiments were repeated under various conditions as to distance, nature of wire used, and forms and quality of terminal mouth and ear-pieces. To enumerate some of the more important experiments:—

1st. About 20 yards of No. 40 copper wire were carried from house to outside, when speaking, singing, breathing, and musical sounds were easily transmitted.

This experiment was arranged in various ways. In the first trial the wire was kept free from touching

any intermediate substance, and was kept in a moderate state of tension by the holders of the pasteboard discs used at either end. Afterwards it was found that, with suitable arrangements, the wire could be led from room to room, thus passing round corners, and that several persons could be in communication at the same time by simply joining on other terminals to the main wire.

2nd. Several yards of No. 23 copper wire were carried from one room through an adjoining one and to a room beyond, the *wire rested on the carpet*, and was simply tightened a little at each end, and fastened to the floor with a carpet tack. Two attachments were then made of a similar-sized wire, and the doors leading to the rooms in connection were *closed above* the wire.

Conversation, musical, and other sounds were then readily transmitted.

In some after experiments, No. 16 copper wire was found to give better results.

Another and somewhat similarly-arranged experiment was made, in which the wire was carried from one floor of house to another, and messages transmitted.

3rd. Attachments were made to a line of telegraph wire, and various forms of terminals tried, when it was found that musical and other sounds were readily transmitted. The attachments were made by No. 23 copper wire, and the experiments were tried at distances of 75 and 150 yards. It was found that there was no appreciable loss in the intensity of the sounds at the greater distance, although an intervening post had to be passed. Breathing, whistling, singing, and the sound of a small tuning-fork, were readily transmitted. Speaking was indistinct, although the word sounds were discernible.

The author believes that, under more favourable conditions, communications might be made in this manner through considerable distances.

4th. About 50 yards of No. 23 copper wire were laid out on grass, and fastened up at ends to pins; attachments were then made, and vocal and other sounds transmitted.

The terminals used were composed of various materials, and were of various forms—the best results were, however, got when the disc or vibrating parts were of pasteboard. If the discs were set in deep rims, clearness of speech was best got by speaking back a few inches from the mouth-piece. With shallow rims the sounds were sharper, but not of such volume.

The best results were got when the wire was attached to centre of disc. Good results, however, were got, although the attachment was made in various ways.

The wires tried were of copper, steel, and iron; the copper wire, however, gave the most satisfactory results. In the case of the telegraph wire, which would be about ⅛ inch thick, and of iron, the volume of sound was considerable; and, indeed, the volume of sound seemed to be increased with heavy wires.

Some interesting results were got by using a common iron wire fence, and attaching terminals at various points apart in the wires of which it was composed. The fence was made up of six wires of $\frac{3}{16}$" and ¼" diameter, and had iron supports at every six feet of its length.

It was found that speaking, singing, whistling, &c., could be transmitted through distances varying from 20 to 60 yards, and that the sound of the tuning fork passed through 100 yards.

Attachments were made to ordinary bell wires, and speaking, singing, &c., could then be transmitted from one room to another.

In all cases the individual voice could be distinguished, and sounds not immediately addressed to the transmitting disc could be heard. Two persons singing together could be heard very beautifully.

The vibratory movements of the discs were insufficient to cause fine sand strewn upon them to move.

From his experiments the author believes that a large part of the vibratory movement must take place in the interior of the wire. This at least seems obvious in the case of the wire resting on the carpet, which showed an improvement in clearness of transmission when kept still by resting on the surfaces with which it was in contact.

From the fact that whisperings and breathings can be transmitted through considerable distances, it is evident that a very small part of the energy expended at the sending terminal can be lost by inducing permanent strain, or by heating the particles of the wire during the transit, and that, in consequence, with suitable arrangements, messages might be transmitted for considerable distances.

(*To be continued.*)

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

VIII.

SINGLE CURRENT SYSTEM WITH RELAY—(*continued*)

THE line current in the single current system being only in one direction, that is to say, its tendency being only to move the relay tongue over to the screw stop connected to M, or towards the "marking" side, a bias has to be given to the tongue which shall normally draw it over to the insulated stop on to the "spacing" side. The amount of the bias required varies with the strength of the line current, and must be regulated by turning the adjusting screw of the relay.

SOUNDERS.

The use of the "Sounder" as a signalling instrument has been for a long period universal in America, but in England it is only within the last few years that it has been introduced; its employment at the present time in the Postal offices is very extensive, there being over 1,500 in use. The forms of the instrument are of two kinds, viz., the standard pattern, which is adopted for all new instruments, and a larger form, which has been constructed partly out of the materials which formed portions of the old "embosser" Morse instruments, which were used to some extent by the Electric and International Telegraph Company. This latter form of instrument, although not perfect in design, answers very well in practice, and a considerable number are at present in use. Fig. 37

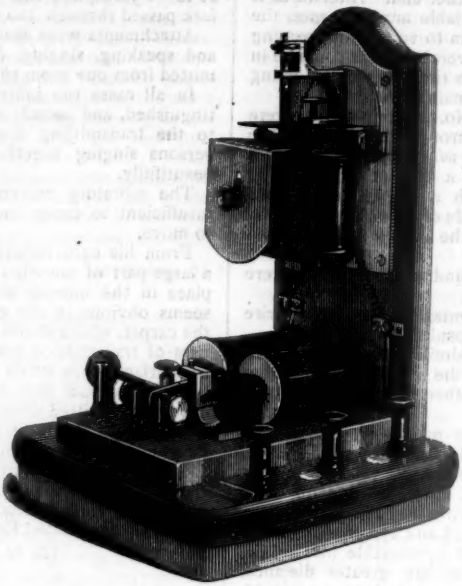


FIG. 39.

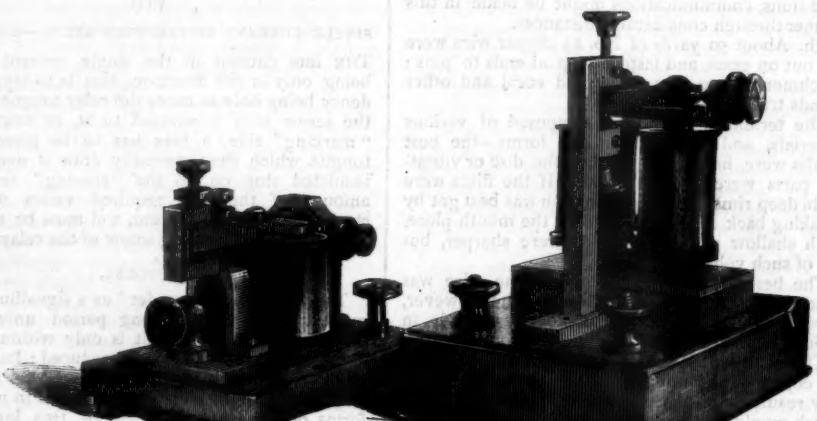


FIG. 38. FIG. 37.

shows this form of sounder. It is mounted on a hollow wooden base, which gives considerable power to the signals. The standard pattern is shown by fig. 38. The lever of this instrument is very solid in form, so that the sounds obtained are very marked, with a very slight amount of play between the limiting stops. The brass base on which the magnet coils, and bridge piece carrying the screw stops are secured, is hollow, to increase the sound given out. The small amount of play to which a sounder can be regulated is very essential for quick action.

As regards adjustments, it is first of all essential that there be a certain amount of play, or "end shake," between the axle and the screw bearings in which the former works; the amount of this "end shake" required is very little, but still a slight amount is absolutely necessary. The lock nuts securing the axle screws should be always kept tight, and should therefore be looked to occasionally, as the constant jars consequent on the working of the instrument is liable to loosen them in time. The lock nuts which tighten the screw stops, between which the lever plays, should also be kept tight. It will be noticed that the screw stop in the standard pattern which limits the downward play of the lever is screwed into the lever itself. This is a much better arrangement than having both the stops screwing into the bridge piece, as they can both be very easily got at and adjusted, which is not the case with other patterns.

In adjusting the sounder for ordinary working, the screw limiting the downward play of the lever should be so set as to allow a clear but small amount of space between the armature and the poles of the electro-magnet.

The sounders, when used for "direct working" (which is rarely the case) are wound to a resistance of 300 ohms; for local working by means of a relay, the resistance of the coils is 40 ohms. The direct working instruments should work well with a current of 7 milliwebers.

Theoretically, and practically also, the maximum "pull" of the magnet on its armature would be obtained if its resistance were equal to that of the battery used to work it; as a matter of fact the resistance of the battery is usually considerably in excess of this. It might, therefore, be thought that a better and more economical effect would be produced by winding the coils to a higher resistance, but there are other considerations besides mere "pull" to be taken into account. Quick working on a local circuit cannot be obtained with instruments of a high resistance, and numerous experiments and practical experience have shown that with the batteries in general use 40 ohms is the resistance which best answers the requirements.

A very great point in the Sounder instrument is its extreme simplicity and its small liability to get out of order.

The rattle of a number of Sounders in a large office might be considered objectionable, but this inconvenience is got rid of by screening off each instrument, or by enclosing the same in a kind of wooden hood, which, to a great extent, confines the sound to the locality where the Sounder is placed.

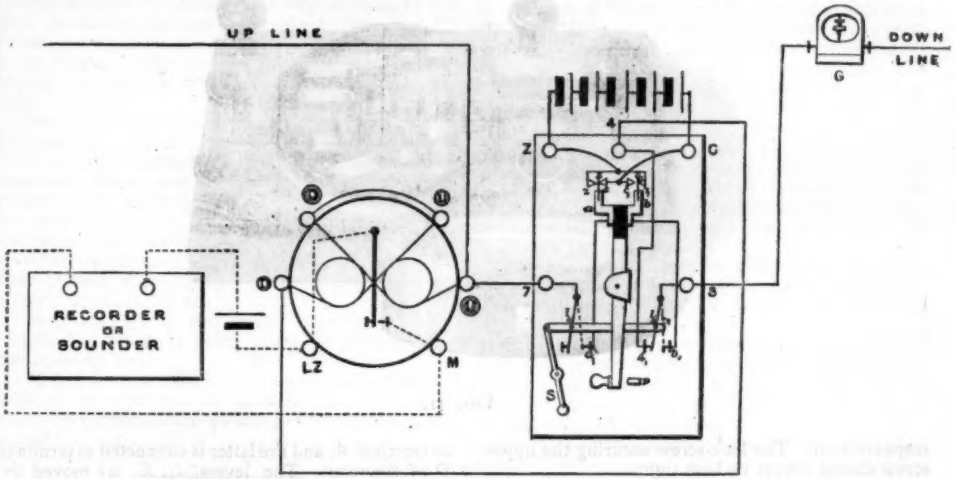


FIG. 40.

The Sounder, although sometimes worked direct, is more frequently worked by Relay; the connections in cases where the working is by "single current," with relay, are similar to those shown by fig. 36 in the last article.

The Bell Sounder.

This form of instrument, which is shown by fig. 39, is used to a limited extent in some of the Postal offices. It consists of a relay and Sounder arranged on a single frame, and is, in principle, merely a "Bright's Bell" instrument cut in half, that is to say, the relay is similar to that employed on the instrument referred to, only one tongue is employed instead of two, and there is only one local bell. The latter is provided with two sounding

plates, between which the hammer of the instrument plays, the upper plate corresponding to the upper screw stop, and the lower plate to the lower screw stop of the ordinary Sounder.

The connections of the instrument possess no peculiarities, being similar to those of an ordinary relay-worked circuit. The resistance of the relay is about 400 ohms; the local Bell has a resistance of 40 ohms.

The tongue of the relay being pivotted between two pointed screws, care should be taken that the upper one of the two is screwed sufficiently down to allow only a very slight amount of up and down movement or "end shake" of the tongue. If the play allowed is too great it will cause the contacts, and, consequently the signals, to be irregular. If, on the contrary, the screw be screwed down too tight, the tongue will be jammed and will not respond at all. The lock-screw securing the upper screw should always be kept tight.

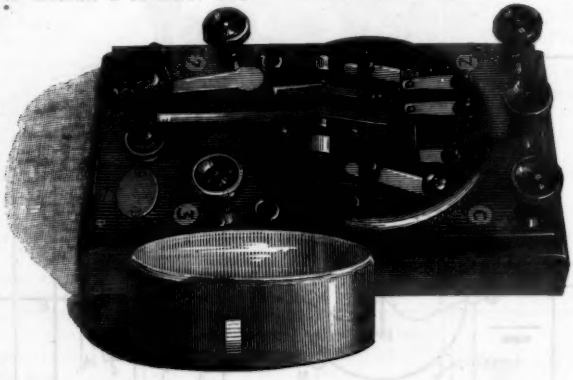


FIG. 41.

DOUBLE CURRENT SYSTEM.

Single Current working, with Relay, from its simplicity, is very useful for lines which are beyond the range of direct working; but which, at the same time, are not of an excessive length. Now, in the Single Current system, as has been pointed out, the line current has to work against a magnetic pull, or bias, which is of a fixed and unvariable strength, unless altered by turning the regulating screw, consequently variations in the line current have to be allowed for by changing the adjustment. On long lines, which are much and continually affected by climatic changes, the need of this continual alteration would prove very troublesome; besides, even if the current did continue constant for any length of time, it would often be too weak to work the tongue of the relay against the necessary bias; on such lines, therefore, the "Double Current" system is adopted. In this system the relay tongue is set neutral, or very nearly so, and the key, on returning to its back position, sends a reverse current, which carries the tongue back to the "spacing" side. To enable signals to be received, the key is provided with a switch, which cuts off the battery and puts the line direct through the receiving relay.

The arrangement of the "Double Current' system will be seen from fig. 40, in which the general principle of the double current key is shown. The lever of the key has two insulated portions, a, b, which are respectively connected to the contact stops, a_1, b_1, of the levers, l_2, l_3; the pieces, a_1, b_1, are provided with prolongations, s, s_1, which play between the contact points, z, z_1, and c, c_1; these points are severally connected with the zinc and copper poles of the battery. Lever l_3 is connected to terminal 3, which is connected to the "Down" line through the galvanometer, G; lever l_7 is connected to terminal 7, and the latter is connected to the U_0 terminal of the relay, and also to the "Up" line. The contact point, 4_1, is connected to terminal 4, and the latter is connected to terminal D of the relay. The levers, l_3, l_7, are moved by means of the switch handle, S; with the latter in the position shown, the apparatus is ready for receiving signals. Supposing the current to come in from the "Down" line, its course is as follows:—From line, through the galvanometer, G, to terminal, 3, from thence to lever l_3, and contact point 4_1, thence to terminal 4; and from there to terminal D of the relay, and through the latter to terminal U and the "Up" line.

When it is required to send, by means of the key, the switch S, and consequently the levers l_3, l_7 connected to it, are moved to the positions indicated by the dotted lines. On depressing the key, the Zinc pole of the battery becomes connected to a, through s coming in contact with z; from a the current passes to lever l_7 through contact point a_1, and from thence to terminal 7 and the "Up" line. The "Copper" pole of the battery comes into connection with b_1 through contact point c_1, and the spring s_1, and thence through b, and l_3 with terminal 3 and the "Down" line.

The connections shown are those for an "Intermediate" station. If the apparatus is at an "Up" station, then terminal 7 of the key or terminal U_0 of

the relay must be put to Earth. If the instrument is at a "Down" station, then the right-hand terminal of the galvanometer G must be put to earth.

It may be noticed that theoretically the lever l_7 is not required, as no current can flow to line from the battery so long as l_3 is moved over to the position indicated by the dotted line; but practically it is found better to cut off both poles of the battery from the apparatus, for if the battery were not well insulated, a "Copper" current, more or less strong, might flow out to the "Up" line, although the Zinc pole of the battery was disconnected.

The actual form of the most recent pattern of the Double Current key is shown by fig. 41. It consists of an ebonite base board screwed on to a wooden frame. The key lever is hinged to two brass hinge blocks, insulated from one another, and connected respectively to the platinum contact points of the switch levers. The lever of the key is formed of two metal parts, insulated from one another by a piece of ebonite between the two; to these metal pieces are screwed the axles which turn in the hinge blocks. The right-hand metal piece is extended, and to it is fixed a knob made of buffalo horn.

The ends of the metal pieces are bent round at right angles, as shown by the fig., and are faced with platinum contacts underneath at their extremities; these contacts normally rest against platinum-tipped springs, corresponding to the contact points, c, c_1, on fig. 40. The upper parts of the angles are likewise furnished with platinum contacts, which when the key lever is depressed, make contact with springs corresponding to the contacts, z, z_1, in fig. 40.

The levers, l_3, l_7, are linked together by an ebonite bar, which is itself linked to the switch handle, s (fig. 40).

The key lever is held in its normal position by a spiral spring connected to an adjusting screw, by which the tension of the former can be regulated if necessary.

THE ROYAL SOCIETY CONVERSAZIONE.

THE Annual Conversazione of the Royal Society was held at Burlington House on Wednesday, April 28th. The spacious rooms belonging to the Society were well filled by representatives of every branch of physical science and by visitors interested in the choice collection of exhibits which is always to be found at the Society's conversaziones.

The microscopic specimens, microscopes, spectroscopes, and philosophical instruments of a like nature mustered in strong array; Messrs. J. Browning, Elliott, Powell and Lealand, Professor A. S. Herschel, exhibiting instruments of very perfect manufacture.

Electrical apparatus was well represented. The President exhibited a Töppler's Influence electric machine, with twenty plates. Messrs. W. Ladd & Co. showed in action one of their well-known six-plate Holtz electrical machines, with ebonite plates; these machines, having their parts enclosed in an air-tight case, are not affected by damp, and hence are always ready for use when required. The same firm also exhibited an improved laboratory Gramme machine, with circular magnets.

The General Post Office showed in action one of the latest forms of Wheatstone's automatic telegraph instruments. This instrument, which is specially constructed for high speed working, is made in two parts, the one consisting of the transmitting portion proper, and the other part being the driving mechanism; by having the latter distinct repairs are more easily executed. By a peculiar and ingenious arrangement the transmitting portion can be easily disconnected from the driving train when required.

Mr. H. R. Kempe exhibited an electrical speed indicator for slow speed engines. Almost all the speed indicators hitherto constructed have been on the centrifugal principle, and require to be adjusted and graduated by trial, and, moreover, require to be fixed close to the driving power whose speed it is required to know. In Mr. Kempe's invention the speed indicator is timed by means of a clock, and thus gives absolutely accurate results, and, moreover, can be placed at any distance from the engine whose speed it is required to indicate. The apparatus is so arranged that at every minute the indicating hand moves to the number of revolutions the engine has made during a particular minute, and remains at that point until the next minute, when it moves backwards or forwards to the number of revolutions the engine has made during that next minute, supposing the revolutions to have been less or greater.

Messrs. Elliott Brothers exhibited a portable reflecting astatic galvanometer, a set of resistance coils, and one of Dr. Lodge's electrometer keys.

Mr. Apps showed a new arrangement of resistance coils, and a Wheatstone bridge, with Admiral Selwyn's galvanometer. A small model electric lamp, for the production of light by arc or incandescence was also exhibited.

Mr. H. A Severn showed his electrical warning compass, by means of which a bell is rung if the ship deviates from her proper course. The invention is as simple as it is effective.

Besides the foregoing, there were a large number of exhibits of philosophical instruments, connected with every branch of physical science, which space will not permit us to allude to.

Notes.

IN the Court of Appeal on Tuesday, April 20th, the case of the Manchester and South Junction Railway Company *v.* the Queen was concluded. It was an appeal by the company against a decision of the Court of Queen's Bench upholding the refusal of the Postmaster-General to pay compensation awarded to the company for the loss of the control of their telegraph wires. The question was whether, under the Telegraph Acts, giving the Postmaster-General power to purchase telegraph lines on railways, he could do so by purchase from the telegraph company without compensating the railway companies. The telegraph lines on this railway having been purchased from the tele-

graph company, who held them under an agreement, unlimited in duration, from the railway company, the railway company claimed compensation and obtained on arbitration, accepted under protest by the Postmaster-General, an award of £6,479. The Postmaster-General declined to pay, on the ground that the arbitrator had no jurisdiction, and on a petition of right by the company to enforce the award the Queen's Bench Division decided against them. The argument urged on behalf of the company was in effect that the railway company had transferred to the telegraph company the power of sending telegrams for money, and that that was all that the Postmaster-General had taken. Their lordships now affirmed the judgment of the Queen's Bench against the company.

AT the last annual meeting of the Paris Physical Society M. Trouvé exhibited his electrical polyscope. The object of this instrument is the illumination of the internal organs of living bodies. An instrument was placed in the stomach of a live fish and the animal illuminated by passing a current through the apparatus. It is stated that the fish did not show any signs of uneasiness, but swam about the aquarium in which it was placed in a quiet manner.

BEFORE the same Society M. Marcel Deprez recently described a new galvanometer adapted for the measurement of powerful currents. The apparatus consists of a number of soft iron needles set between the poles of a powerful permanent horse-shoe magnet, and are thus magnetised by induction. A few turns of thick wire are wound around the needles in a direction parallel to their length; thus a galvanometer is formed, the needles of which are held in a state of equilibrium by the powerful directive action of the permanent magnet, and are thus only able to turn through an angle of a few degrees by a powerful current.

M. DEPREZ also exhibited an apparatus for measuring the amount of power developed by a current. The instrument consists of an electro-dynamometer formed of a movable coil which can turn within a fixed coil. A portion of the current whose energies to be measured passes through the outer coil, and a smaller portion through a resistance and through the inner movable coil. By noting the turning power exerted on the movable coil, the amount of work exerted by the current can be accurately determined.

IF rumour speaks truly, we are to hear shortly of another scientific invention worthy to stand beside the telephone or the phonograph in point of interest. Announcements of a mysterious *telephote* or *diaphote*, the discovery of two rival American inventors, have lately appeared in the paragraph columns of the non-scientific press, the instrument or instruments in question being declared capable of transmitting light as the telephone transmits sound. The rumour to which we allude, however, and of the truth of which we have authoritative information, is based upon the fact that Prof. Graham Bell has deposited in the Smithsonian Institution a sealed package containing the first results obtained with a new and very remarkable instrument first conceived by him during his sojourn in England in 1878.—*Nature*.

WE learn that Messrs. M. Theiler and Sons are about to bring out a new telephone. The transmitter is said to be exceedingly simple, requiring no adjustment whatever, while the receiver is stated to be much louder, without being less distinct, than the Bell telephone. We hope to describe the apparatus fully in our next issue.

MR. W. T. HENLEY is manufacturing a 3-inch cable for the Montreal Telegraph Company. The dielectric of this cable is formed of an ozokerit compound.

ACCORDING to some experiments made by M. Ziloff, the magnetic co-efficient of an aqueous solution of perchloride of iron varies with the magnetising force.

MR. JAMES SIVEWRIGHT, general manager of the telegraph between the Cape of Good Hope and Natal, has been gazetted to the most distinguished Order of St. Michael and St. George, for services rendered in South Africa during the late war.

THE catalogue of the Ronald's library has been completed by Mr. A. J. Frost, and will shortly be ready for publication. The catalogue will be something more than a mere list of the works contained in the library, as many valuable notes have been compiled and printed in the volume.

A COURSE of lectures on "Electrical Testing as applied to Telegraphy" is now been delivered by Professor W. C. Adams, at King's College, London. The series commenced on Friday, 23rd inst.

THE report that the Western Union Telegraph Company have paid Mr. Edison 100,000 dollars for the sole right to use his electromotograph in connection with telegraphy, is stated to be incorrect. The company having paid only a nominal sum down, the remainder being conditional on their working the patent, which they are not likely to do.

MM. LEBLANC and LOISEAU have invented an automatic electrical railway block telegraph instrument. The apparatus consists of a lever or pedal, placed close to the railway metals, so that it can be moved by the action of the wheels. The movement of the lever acts upon a relaxing arrangement, which in its turn works a commutator. Thus the apparatus serves to put a battery in communication with an electric bell at the signal station. A peculiarity in the arrangement lies in the fact that the lever is moved by the action of the first wheel of the train, and then remains moved away until the last carriage has passed, thus the lever is not subjected to the hammering of each wheel as it passes, which would result in the derangement of the mechanism in a very short time if continued.

ACCORDING to Le Comte du Moncel, a little ball of pith is strongly attracted by a strong horse-shoe magnet, the poles of which are provided with large soft iron pipe pieces, placed very close together. The phenomenon is very marked at a distance of four centimetres.

THE Edison Telephone Society is now in full operation at Paris, with over 350 subscribers. The carbon transmitter and the Phelps receiver are used. The lines are laid down by the State, and a complete closed circuit is employed in order to avoid induction currents. Successful experiments have, it is stated, been made up to distances of about 140 miles.

THE WIRE AGE.—Until within the past four years the wires were capable only of transmitting signals of a complex nature, but easily understood and interpreted by experts; now, human beings talk with each other over the iron, and it seems to make, as it were, a unit of the great family of man. Words, actual words, produced by the organs of speech, are ever winging their way, with the speed of lightning, over cities,

across rivers and mountains and woods, and voices are recognised scores of miles away. The wires needed in cities for transmitting fire and burglar alarms, for police calls, time signals, and other municipal purposes, are many in number, and when to these are added the wires for telegraphic and telephonic purposes, the question of space or room for them becomes an important one. These wires must all be independent of each other; there must be no contact anywhere, else serious errors and complications occur. In this city the fire alarm system has been so often interfered with that the chief engineer has called the attention of the city government to the matter. The time is not far distant when additional wires will become necessary for the purposes of electric lighting, and, perhaps, warming. In the years to come the whole country will be covered with them unless some plan is devised by which electrical currents can be conveyed in the earth by wires protected in tubes of clay or metal. It is certain that some method of this nature must be adopted, and that quite speedily.—*Boston Journal of Chemistry.*

UNDER the title of Electrical Gyroscope, MM. De Fonvielle and Lontin have brought before the Paris Academy an apparatus for producing gyratory motion by electrical means. The instrument consists of an ordinary horizontal galvanometer coil, within the axis of which can be balanced like a compass needle pieces of soft iron of various shapes, such as a star, a disc, &c. If one of these pieces of soft iron be suspended, and a series of rapidly reversed currents be sent through the coil, then on imparting a rotatory motion to the soft iron disc or star the latter will continue and rapidly increase its rate of revolution until an extremely high rate of motion is attained. If a permanent horse-shoe magnet be placed vertically over the coil, with its poles downwards, then it is found that if the poles are on a line parallel to the wire of the coil, the motion of the rotating mass of iron is accelerated; if, on the contrary, the poles are set at an angle to this position, the motion will be retarded, and if the angle be a right one, then the motion is generally stopped. The phenomenon is accounted for by the discoverers in the following way:—The molecule of iron acts in its movement of rotation in two different ways in each of the two nearly equal currents of induction which successively traverse the turns of wire. In fact, during the whole continuance of the two phases of rotatory movement which the galvanometric frame brings closer together, each molecule of soft iron increases the intensity of the current which affects it, and at the same time it diminishes that of the current which repels it. In the two other phases of its movement the same molecule diminishes the intensity of the one current, which then tends to draw it back, and increases that of the other current, which turns it away from the frame. The actions exerted in the two phases of the movement, that is, in the total extent of the plane described by the molecules, tend then to keep up the continuous rotation, which progressively increases in speed until it reaches that which corresponds to the absolute intensity of the attractions or repulsions exercised by the currents induced.

WABASH, Indiana, has been successfully lighted by electricity. On the night of the first day of April four Brush lamps of 3,000 candles power each put forth a noonday light for one mile in circumference. The lamps, suspended midway of the iron flagstaff on the Court House, which towers one hundred feet above the business part of the town, were furnished with electricity by a No. 5 generator, driven by a seven horse-power engine. According to contract the light was to equal a gas burner 2,640 feet from the light, and it gave general satisfaction. That city is the first in the world to adopt the electric light for general illumination.

THE electric lighting of the Metropolitan Aldersgate Street Station during the last seven months has given such satisfaction that the Railway Company have determined to adopt it for several other stations as well. The light will be temporarily discontinued in order that the Electric Generator and Light Company who are supplying it may make the necessary arrangements for the permanent lighting.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of this Society, held April 14th, Mr. W. H. PREECE, President, in the chair, the minutes of the last general meeting having been read and confirmed, a note by Prof. HUGHES. on "Some Effects Produced by the Immersion of Iron and Steel Wires in Acidulated Water," was read by the SECRETARY.

It was found that if steel wires were immersed in acidulated water containing $\frac{1}{10}$th of its volume of sulphuric acid, the wires became very brittle. That these results were not accidental was proved by repeated experiments. The proportion of the acid in the water did not affect the results. The effects noticed were only produced in iron and steel, other metals were not affected. The effect produced was probably due to hydrogen being absorbed, but the metal rendered brittle did not possess any peculiar property observable on the "Induction Balance." If the acidulated water was weak, then a proportionately longer time was required to produce the brittleness. With part of acid to 20 of water the time required was 30 minutes. If the steel acted upon formed the electrode of a cell with copper as the other metal, then the effect was much more marked when the cell had its circuit kept closed. If zinc was used instead of copper, the effect was less marked.

Any kind of acid produced the effect noticed, but the time taken to produce the effect varied with the nature of the acid. The effect could also be produced in water if another metal were coupled to the steel.

If steel wires are plunged into acidulated water with hydrogen developed in it by means of the action of zinc the brittle effect produced was very marked. Rods of a quarter inch diameter were affected equally with thin wires, but the time in the various cases differed according to the thickness of wires or rods. Heating the brittle wires restored their flexibility.

It was found that an iron wire plunged into acidulated water became more electro-negative after a time than at first. As soon as the hydrogen began to develop, the degree of polarity became constant.

Short circuiting a cell formed of iron and zinc at once made the cell constant. Iron produced a much better effect than platinised silver, as in a Smee cell.

By plunging an iron rod into mercury containing zinc covered with acidulated water, the zinc dissolved out very rapidly, and the metal could thus be easily purified.

If several metals were coupled up together and connected to a zinc in acidulated water, the iron alone gave out hydrogen. Carbon became most polarised of any metals in a cell.

Mr. CHANDLER ROBERTS then read a note on Prof. Hughes' communication. Graham showed that all metals absorb gas, and that palladium "occluded" 900 times its volume of hydrogen if heated in the latter, and then allowed to cool or made the negative-electrode in a battery. The effect of the absorption was to expand the metal 2 per cent. Platinum also absorbed hydrogen and became expanded in so doing. This was shown by experiment, the platinum electrode being connected to a long light index which showed the expansion. If the direction of the current through the cell was changed so that oxygen became developed on the piece of platinum in question, then contraction took place, the effect in both cases being slow. Mr. Roberts suggested that in Professor Hughes' experiments hydride of iron possibly became formed.

As regards some experiments made with thin films of iron, it was suggested that acid and not hydrogen became absorbed in the pores of the iron.

The reason of the brittleness produced in the steel was difficult to get at; possibly it was caused by the entry of the hydrogen re-arranging the particles of iron and causing a crystalline effect.

Prof. ABEL stated that he had made some experiments on the brittleness of steel, and he took the same view of the matter as did Mr. Roberts. The quantity of natural gas contained in iron varied from 3 to 10 per cent.

Mr. STROH had made some experiments to determine the depth of the brittle structure of the steel. A rod ¼-inch thick was plunged into acidulated water for half a minute, and then filed to remove the surface. The brittleness was not removed by this process. A repetition of the filing for several times proved that the brittleness had penetrated the mass of the metal. The "tensile strength" was *not* altered by the action of the acid.

Mr. ANDERSON, who had served on the hardening and tempering of steel committee, thought that the effect of hydrogen was to allow the opening or drawing closer of the particles of iron.

When heated steel is suddenly cooled, the particles come together very quickly, and the effect of hydrogen may be similar.

Prof. ADAMS pointed out that the experiments bear in one direction, viz., upon the separation of the molecules of the metal; the effect, therefore, may be to reduce the cohesion. It is well known that alloys of metals have a lower melting point than that of the metals individually, the reason being that cohesion is diminished.

Mr. WILLOUGHBY SMITH said that formerly the joints in the copper conductors of cables were formed by silver-solder, with resin as a flux. These joints became very brittle. With soft solder and spirits of salt as a flux, the joint became brittle if the spirit was not washed off after the joint had been made.

Prof. PERRY considered that Mr. Stroh's experiments on the tensile strength of the steel arms were not conclusive. In reply to Prof. Adams, he pointed out that some alloys are actually stronger than the metals individually.

Mr. KEMPE next described some experiments he had made, at Prof. Hughes' request, to determine the electromotive forces of various couples. The results obtained were as follows:—

Battery.	Electromotive Force.
Daniell	1·00
Zinc—Iron	·56
„ —Copper	·95 (variable)
„ —Amalgamated Copper	·16 „
„ —Carbon	1·21 „
„ —Platinum	1·05 „

The polarisation observed on short-circuiting the battery for one minute was as follows:—

Daniell	9·7 per cent.
Zinc—Iron	12·0 „
„ —Copper	50·0 „
„ —Amalgamated Copper	45·0 „
„ —Carbon	60·0 „
„ —Platinum	51·0 „

The Zinc-Iron couple gave a very steady current.

Mr. TREUENFELD stated that the effect of galvanising wire was to render it brittle.

Prof. AYRTON said that when the elements of a battery were first immersed in the fluid the electromotive force rises.

Mr. J. MUNRO suggested that the effect of hydrogen was to fill up the pores of the steel wires experimented on, and thus, by preventing the yielding of the metal when bent, to cause the brittleness.

Prof. HUGHES in reply stated that contrary to the generally accepted theory, iron forms an excellent negative element for a battery. The electromotive force of a zinc-iron couple is very high, and the resistance very low.

The PRESIDENT pointed out that the use of iron for batteries was first prominently brought forward by Callan of Maynooth.

Mr. STROH next read a paper on "The Adhesion of Metals, produced by Currents of Electricity." If two steel wires were brought into contact with one another crosswise, a battery being connected to them, the wires adhered with a considerable amount of force. A single bichromate element was sufficient to cause this effect. If the battery were increased, the adhesion was diminished. Experiments were tried with two knife edges brought in contact crosswise, a current flowing between them. The amount of power required to separate them with different metals was found to be as follows:—

Copper	·15
Silver	·15
Aluminium	2·50
Brass	8·50
Zinc	11·00
Tin	14·00
Gold	17·00
Lead	18·00
German silver	28·00
Platinum	42·00
Iron	85·00
Soft steel	100·00
Hard steel	225·00

By examination of the contact edges under a microscope, it was found that the effects were due to fusion. It was noticed that the points of adhesion, in the case of steel, became extremely hard. The knife edges, when stuck together, would bear a considerable amount of tension without becoming separated. In the case of steel edges, the striking power was so great that a half-pound weight could be hung to them without producing a separation.

The PRESIDENT having made a few remarks, the meeting then adjourned.

AT the ordinary general meeting of the Society, held April 28th, Mr. W. H. PREECE, President, in the chair, Professor AYRTON gave the results of some experiments made to determine the quantity of current flowing in the electric arc, by observations of the shapes of the crater produced in one of the electrodes. The results obtained were as follows:—

Depth of crater. Inches.	Area of crater. Inches.	Current in Webers observed.	Current calculated from crater.
·140	·0196	9	9·9
·156	·0243	12	12·4
·186	·0272	...	13·8
·203	·0324	...	16·5
·266	·0556	29	28·3
·326	·0825	42	42·0
·453	·1602	81	81·6

A paper by Mr. OLIVER HEAVISIDE on "The Resistance of Galvanometers" was then read. In this paper the author showed that whatever the shape of the coil was, and whatever the thickness of the silk covering on the wire, the law that the maximum effect was produced by the coil when its resistance was equal to the external resistance, always held good.

A paper by Mr. C. HOCKIN, M.A., on "The determination of the position of faults in a cable when two exist at the same time," was next read by the SECRETARY.

Mr. HOCKIN first pointed out that when tests could only be made from one end of a cable, the difficulty of localising a fault was very great, owing to the continual variation in the resistance of the fault. A method had been suggested of localising faults by taking a resistance and a discharge test; the latter was a matter of some difficulty, owing to a large portion of the current becoming lost whilst the discharge key was moving from its charge to its discharge contact.

In localising faults eleven different measurements were possible, of these six were resistance measurements, two potential measurements, two current measurements, and one a ratio measurement. By combining these tests it was found that in the case of a cable with two faults an equation of the third degree could be obtained, which would enable the locality of the faults to be obtained. The solution of this equation could only be obtained by the "trial" method, but this could be done without a great number of numerical calculations, ten trials usually being sufficient to enable the result required to be arrived at.

In the discussion which followed the reading of Mr. Hockin's paper, Mr. KEMPE pointed out that the difficulty mentioned by Mr. Hockin, with reference to a test made by a resistance and a discharge measurement, had been overcome by himself, and the method had been described in the TELEGRAPHIC JOURNAL for September 15th, 1879.

Mr. H. R. KEMPE then read a paper on "Testing by Received Currents." The good maintenance of a system of telegraph lines can only be accomplished in a satisfactory manner by a good system of testing. The need of some system is unquestionable, but no law can be laid down as to what is the best method to adopt. The system adopted in the Postal service in England was a very simple one, no elaborate formulæ or intricate tests being used or required. The stretches of line between any two testing stations did not exceed 15 or 20 miles, consequently, elaborate tests for localising faults were unnecessary. The station had merely to disconnect or earth the faulty line at their stations in succession, and then it was easily seen in which section the fault existed.

Two kinds of tests are made, viz.: "Monthly tests," for insulation and conductivity, by means of which the general condition of the lines is ascertained; and "Daily tests," by which the working condition of the lines is ascertained before the heavy day's work begins.

The monthly tests are taken by means of a Wheatstone bridge, the insulation test being made with zinc to line, and the conductivity tests, first with zinc and then with copper to line, the arithmetic mean of the two results being taken as the true conductivity. The tests are entered on printed sheets, certain deductions being made for the resistance of instruments and underground work.

The daily tests are made by sending currents through the various lines, and measuring the amount of current received at the ends of those lines. The amount of battery power sending the current being known, and the resistance of the line being also known, then by dividing the electromotive force of the battery in volts by the resistance of the circuit, the result obtained is the current going out and leaving the end of the line when there is no leakage; by comparing, therefore, this calculated result with the actual current received, the condition of the lines is at once known.

The measurements are made by means of a tangent galvanometer which has a coil of 320 ohms resistance and a resistance coil of 750 ohms. With the two resistances in current a standard Daniell whose electromotive force is 1·07 volts will give a current of $\frac{1{\cdot}07}{750+320} = {\cdot}001$ weber or 1 milliweber is obtained the deflection obtained, therefore, is equal to a current of 1 milliweber. If the standard battery be removed and the line put in its place, then the deflection obtained, which is due to the current from the line, at once represents the strength of the current by a simple proportion sum. Tables, to save the trouble of calculation, are used to estimate the values of the deflections.

The received currents are measured with the 750 ohms resistance in the circuit, so that if a line be faulty near the testing end the fault can be noticed; this would not be the case if there were no resistance in circuit, as the major part of the current would pass through the galvanometer, and but little through the fault, which would thus appear not to exist.

In the discussion which followed the reading of the paper, Mr. BETTS pointed out that the number of wires to be tested in the Postal offices was so large that even if elaborate tests were advisable they could not be taken for want of sufficient time. He had formerly had to test thirty-four wires in fifteen minutes.

Professor AYRTON said that he agreed with Mr. Kempe, with reference to the remarks he had made on the testing in India. In that country faults were enabled to be localised and traced out during the night; the stretches of line were very long, and thus accurate localisation by testing was necessary

In conclusion, the PRESIDENT said that the good working of the lines was greatly due to the efficient system of testing.

PHYSICAL SOCIETY.—APRIL 24th.

Professor W. G. ADAMS in the Chair.

New Members—The Marquis of BLANDFORD, Mr. J. MARSHALL.

Professor G. C. FOSTER read a note by Professor Rowland, of Baltimore, U.S., on the discovery of Mr. Hall, that a magnet exercises an electro-motive force on a current in a conductor crossing its field as well as a force on the conductor itself. This fact will render it necessary to apply a correction to equations which assume that only the latter force acts. The electro-motive force in question is at right angles to the direction of the current, and to the lines of magnetic force. Professor Rowland expresses it mathematically in this note, and bases a new method of determining the value of v, the ratio of the electrostatic to the electro-magnetic unit of electricity which gives v almost identical with the velocity of light, thus confirming Clerk-Maxwell's theory of the nature of light. Dr. J. HOPKINSON, F.R.S., suggested an expression for one of Professor Rowland's results.

Professor FOSTER also read a note by Professor Wild, of the Central Russian Meteorological Observatory, on a mode of correcting the bifilar magnetometer for

torsion of its fibres, &c., and a method for finding the horizontal component of the earthy magnetism by its aid.

Mr. RIDOUT, F.C.S., described an improved thermo-electric apparatus, of his construction. The author has followed the idea of combining the thermo-pile and galvanometer in one instrument on the same base-board. The defects of the apparatus, as ordinarily made, are a too great disparity between the resistance in the pile and in the galvanometer; the junctions of the pile are too deep, and short-circuit the current; the bars too long and resisting, as well as too numerous; the junctions too slender; the mass of matter to be heated too great. These defects are remedied by placing the bars in glass tubes, connected with thin plates of copper; making the bars half the usual length, and using only a single pair. The defects in the galvanometer are that the wire does not come near the needle; the needles are not of the best form; and the suspension is troublesome. Mr. Ridout makes the wire a flat ribbon mounted on one bobbin; the needles are flat oblong plates from the same piece of steel, and magnetised in one piece; they are mounted on a pivot turning in an agate cup. The several parts of the apparatus are mutually adapted to each other; and in using it the galvanometer is not joined to the pile till the latter has been exposed to the heat, so as to prevent the current generated abstracting heat from the hot side. As made by Mr. Browning the pile consists of a pair of elements $\frac{1}{4}$ in. long, the copper connections being circular plates $\frac{1}{100}$ in. thick, and $\frac{5}{8}$ in. diameter. The pile is supported by thick copper terminals above the galvanometer, which consists of a copper ribbon, making some 20 turns round a pair of astatic needles 1 in. long, and $\frac{1}{4}$ in. broad, pivotted in an agate cup; a contact key, placed on one side, and the whole is enclosed in a glass shade, perforated opposite the pile. A glass cone protects the front from extraneous heat, and a glass case the back. A directing magnet is fixed above the pile, contact between the galvanometer and pile is made after, say, 30 seconds' exposure to the heat. The pile is affected by a person standing 6 feet from it, and the radiation from stellar space is evident in clear weather. Half a minute is sufficient to put the instrument ready for use. Mr. Ridout also exhibited laboratory experiments showing cohesion in mercury by causing it to overflow up an inclined trough; electrolysis of water by a single Grove or bichromate cell, through diminishing the pressure in the flask containing the water by boiling it, and condensing the vapour on cooling; a differential thermometer showing absorption of heat on liquifying solids; and the production of musical notes in glass tubes by contracting the bore smoothly to about one quarter of the diameter at one part. Professor FOSTER remarked that the cohesion experiment might show the surface tension. Professor GUTHRIE and Professor HUGHES offered remarks on the electrolytic experiment, the latter stating that he finds the resistance of an iron cell, he has constructed, to depend on the electrodes rather than the liquid; when the negative plate is tempered iron, the resistance is low, when soft iron it is high.

Professor STONE exhibited photographs of König's new tonometer, described by him at the last meeting, and further mentioned that König had devised a thermometer based on the principle that changes of temperature produce corresponding changes in the vibration rate of a tuning-fork. The temperature is found from the rate of the fork by bringing it to a zero rate by means of a rider.

Professor MICHIN then described his experiments to solve the problem of transmitting light by photo-electric action. Two years ago he conceived the idea of employing for this purpose the fact that light falling on a sensitised silver plate disengages electricity. He forms a sensitive cell composed of two silver plates immersed in a conducting solution; one plate is coated with a sensitive emulsion of chloride or bromide of silver. When chloride is used a solution of salt in water forms the liquid, when bromide a solution of bromide of potash. A current is set up in this cell even in the dark, but when exposed to the magnesium light the current is very powerful and flows within the cell from the uncoated to the sensitised plate. Professor Michin also conducted this current by wire to a second cell in a dark chamber and found that it effected a decomposition of the sensitive plate in that cell, as shown by a distinct darkening of the plate when "developed" by pyrogallic acid. The same effect was produced whether the current was reversed or not. Professor Michin is continuing his experiments, and has provided a cable containing a number of separate conductors insulated from each other, in order to convey the currents from several cells.

Professor PERRY feared that the effect would not be strong enough; but Professor MICHIN said the light of a match produced a decided photo-electric effect in the cell. Professor PERRY alluded to the selenium plan proposed by himself and Professor Ayrton, and said that Mr. Willoughby Smith had observed selenium to be sensitive to the shadow of a flying swallow. Professor ADAMS testified to the sensitiveness of selenium and its power of being directly excited by light, a fact first proved by the experiments of Mr. Day and himself.

New Patents—1880.

1475. "Improvements in the manufacture of telegraph cables or conductors and in insulating apparatus therefor." F. WIRTH. (Communicated by M. M. & R. P. Manly and W. J. Phillips.) Dated April 10. Complete.

1496. "An improved machine, which, when placed in electric communication with a piano, harmonium, or organ, prints the music as it is played." HY. DICKINSON. Dated April 12.

1507. "Electric lamps." G. G. ANDRÉ. Dated April 13.

1510. "Insulators for supporting and securing telegraph and other wires." G. WELLS and A. GILBERT. Dated April 13.

1511. "Telephone switches." J. W. JOHNSON. (Communicated by E. Marx, F. Aklemm, J. Kayser, and L. Davis.) Dated April 13.

1552. "Electric lamps." A. M. Clark. (Communicated by M. A. Gérard-Lescuyer. Dated April 15.

1553. "Electric lamps." C. D. ABEL. (Communicated by the Compagnie Générale d'Eclairage Electrique.) Dated April 16.

1580. "Dynamo-electric machines." E. P. ALEXANDER. (Communicated by K. Zipernowsky.) Dated April 17.

1585. "Improvements in and appertaining to electro-magnets." G. SCARLETT. Dated April 17.

1649. "Improvements in and relating to electric lighting apparatus and the manufacture of carbonised material to form conductors for the same, and for other purposes. W. R. LAKE. (Communicated by H. S. Maxim.) Dated April 21.

1704. "Electric lamps." H. J. HADDAN. (Communicated by A. Bureau.) Dated April 26.

1705. "An improved bath or liquid compound for the deposition of aluminium." L. A. DAVIS. Dated April 26.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

3259. "Time indicators." MELVILLE THOMSON NEALE. Dated August 13. 6d. Has for its object improvements in the means of transmitting time by electric currents, and consists in the addition to any ordinary electric indicator of time of a relay arrangement, by which a local battery and circuit are thrown into action to move the hands of each indicator at the moment of a passage of an electric pulsation through the main or line circuit.

3368. "Joinings for wire fences, telegraph wires, &c." THOMAS YOUNG. Dated August 21. 2d. A rectangular slot is made through the joining or coupling piece in the direction of its length, and in each end of the said piece a hole or passage is made extending inwards to the slot. The holes are approximately of the diameter of the wires to be joined, and the said wires are passed through, and the end of each is flattened or broadened on the other side. *Provisional only.*

3436. "Galvanic batteries." R. C. ANDERSON. Dated August 26. 6d. Consists of the ordinary positive and negative elements, such as zinc and carbon, the former of which may be acted upon by any suitable acid, say for example sulphuric or muriatic acid, or a salt of an acid. With the latter is used oxalic acid in combination with a solution of bichromate of potash, to which is added a suitable acid or salt of an acid. These positive and negative solutions may be employed either mixed together as a one-fluid battery, or separately, by means of a porous pot dividing them as a two-fluid battery.

3476. "Microphonic apparatus." W. P. THOMPSON. (Communicated by M. Leon de Locht, of Liege.) Dated August 29. 6d. Consists in a very thin but rigid wooden, metal, or other "planchette" board or plate, which carries a prism of graphite, and is movable round one of its edges as an axis. The movements of the "planchette" are limited in one direction by springs, and their extremities in graphite, are limited in the other direction by the pressure of an antagonistic spring, which can be regulated at will.

3479. "Electric signalling apparatus for railways." W. ROBINSON. Dated August 29. 8d. Has for its object chiefly the automatic operation of electric signals on railways by means of passing trains, the rails of the track being used as principal conductors of the electric current.

3509. "Regulating mechanism for electric lamps." ROOKES EVELYN BELL CROMPTON. Dated September 2. 6d. Describes the regulator fully detailed on page 131 of our last issue.

3525. "Telegraphic recording apparatus." ROBERT KIRK BOYLE. Dated September 3. 6d. Relates to further improvements in apparatus described in a former patent, dated December 30, 1878, No. 5313, and is designated to provide means whereby the working of the said apparatus will be more accurate than has heretofore been practicable.

3565. "Dynamo-electric machines." W. ELMORE. Dated September 4. 8d. Describes the machine illustrated in our issue of April 1, 1880, page 116.

3587. "Electric lamps and switches therefor." F. J. CHEESEBOROUGH. (A communication from W. E. Sawyer, of New York.) Dated September 6. 6d. The lamp consists notably of a long carbon pencil interposed between two large carbon electrodes, the long carbon pencil being fed up magnetically from the outside of the globe in which the arrangement is enclosed. The globe is filled with a carbon preservative atmosphere.

3645. "Electric telegraphs." W. CHASE BARNEY. Dated September 11. 6d. Has for its object to increase the rapidity with which messages may be transmitted through long lines of electric telegraphs, and more particularly through submerged cables, by diminishing induction, by diminishing the duration of charge and discharge, and avoiding the effects of the secondary discharges on the receiving instrument.

City Notes.

Old Broad Street, April 28th, 1880.

EASTERN EXTENSION TELEGRAPH CO.—The thirteenth ordinary general meeting of this Company was held on Wednesday, the 21st inst., at the City Terminus Hotel; Mr. John Pender, M.P., in the chair. The report and statement of accounts were taken as read. The Chairman, in moving the reception and adoption of the report, delivered the following address: Gentlemen, before making a few general remarks, I will refer more particularly to the report. The gross receipts for the half-year ended December 31, 1879, have been £165,930; for the corresponding period of 1878 they were £140,976, showing an increase of £24,954. The expenses for the past half-year have been £68,683, for the corresponding period of 1878 they were £71,249, or a decrease of £2,566, caused probably by a reduction in the cost of repairs. The net revenue for the half-year has been £97,247; for the corresponding period of 1878 it was £69,726, showing an increase of £27,521. One interim dividend of 1½ per cent., yielding £24,968, has been paid for the first half-year, and it is now proposed to distribute another of like amount on the 22nd instant, leaving, with the balance brought forward from the previous half-year, £81,970 for the reserve fund, which now stands at £157,870, or equal to about 8 per cent. of the share capital. I want to draw your attention particularly to this remark: the amount taken from the reserve fund in 1877 for laying the Penang and Rangoon cable, I believe, was £155,000. If this sum had been raised by 6 per cent. debentures the revenue would have been subjected to an annual charge of £4,000 for interest. The heavy cable repairs which the Company has had to pay since the amalgamation, a period of seven years, have cost £155,000. In other words, but for these repairs the shareholders might have had an increased dividend, say of about 1½ per cent. If the ships' expenses when in harbour, which are also part of the cost of repairs, £63,000, are included, the total cost would be £218,000, or about 1½ per cent. per annum since the formation of the Company. The duplicate Australian cable has been successfully completed since the last meeting. It is laid direct from Singapore to Banjoewanje, thus avoiding the Java lines, by which a considerable saving of time has been effected, and increased efficiency obtained, as the messages pass now through English hands. A continuous night and day service has been established with Australia, and has given great satisfaction to the public, as we are now able to transmit messages, allowing for the difference of time, in about six hours. The interest on the new

capital raised on this cable is fully met by the Government subsidy of £32,400 per annum. It must not be forgotten that the addition of 2,500 miles of cable to the Company's already existing system of 7,369 miles makes a total of about 10,000 miles of cable, and involves an additional charge for keeping it in proper order, thereby rendering a reserve fund the more necessary. The China section of the cable is already worked night and day, and is adding very materially to the traffic of the Company, and it is also satisfying our constituents. The transmission between London and China is carried on in about three hours. The Manilla section, which I referred to when I last addressed you, is now in course of being completed. We expect in a very short time to learn that the ship has laid the cable. That system is now incorporated with our present system. From that we also expect additional traffic. The cables, I am happy to say, are all in good working order, and probably I have never had any occasion to address you when the whole system has been in a more efficient and more satisfactory state for earning than at the present time. We are deriving some advantages from the improved state of trade; and, as I have often repeated, as trade begins to move, either upwards or downwards, telegraph companies are generally affected. Now, gentlemen, I have pretty well given you the real points referred to in the report which is in your hands, and beyond congratulations on the present very satisfactory position of the Company, the very large increase in the traffic, arising no doubt from, as I have said, an improvement in the trade and the duplication of our system to Australia, there is very little more to be said. There is one question to which attention has been drawn—and I may as well meet it at once—namely, the question of the reserve fund. I am bound to say, that looking to the history of submarine telegraphs, it is a property which cannot be considered a secure property unless we have our systems duplicated and our reserve fund at a point that will meet any emergency, and the requirements of immediate action in putting that system into order. If we had an inadequate reserve fund our property would be a fluctuating one, and I can see no sound ground for stability unless we have such an amount as will enable us to put our cable in order, and if necessary go largely into laying a new cable. Now, gentlemen, there is one point which I will refer to in support of this, and as illustrating more completely and more fully the views which I hold on the subject. I mentioned that when we laid the Rangoon and Penang duplicate cable we were not as well to do as we are at the present time, and we thought, instead of coming to the public with debentures, and making it almost a permanent debt on the Company, it would be better to take from the reserve fund the amount required to make that duplication. That received the approval of the shareholders generally. At the same time, in taking that amount from the reserve fund, we weakened our reserves to that extent. My proposition now is, and I hope that the shareholders who look to a steady dividend and a certainty instead of an uncertainty will support me in it, that we should replace that £150,060 before we talk of an increased dividend. If we go on at the same rate as we have during the past year that amount will very soon be obtained, and we will then stand with a reserve fund considerably over £300,000. We shall then be able to apply a fair proportion of our earnings to increase that sum, to bring it up to probably half a million, and at the same time to give to our shareholders an additional portion of dividend. Gentlemen, these are the views which your board hold. I think they are sound, practical, business-like views; and I am satisfied that it will be of great advantage to the Company and of this property in every sense if these views are approved of by the shareholders and carried out by your directors. If we pursue any other policy, and go and divide the amounts that we earn, all that I can say is that we shall not be studying the interests of a certain class of investors. There is a certain class of investor sin this Company who hold very small amounts, and there is no doubt that they prefer a safe and steady dividend of 5 per cent. to a fluctuating one, which it must be if we increase our rate at the present moment. I should be glad to hear any gentleman's opinion for or against the statement which I have made. I am hopeful that those who take my view will support it from the body of the meeting. Now, gentlemen, to be in form, I shall, before any one addresses us, move that the report and accounts of the directors, now submitted, be received and adopted, and that a dividend be declared of 2s. 6d. per share, payable on the 22nd inst., making, with the interim dividend already paid, a total of 3 per cent., free of income-tax, for the year 1879. The Right Hon. W. N. Massey, M.P., vice-chairman of the board of directors, seconded the motion. Mr. Marshall observed that it was suggested to the Company two or three years ago that they should take their 5 per cent. dividend and rest contented until the cables were duplicated. Now the cables were duplicated they were asked to rest until they had half a million reserve for repairs. It would therefore become a misfortune to the Company to have duplicate cables, because they were to be starved to keep them in repair. £27,000 net gain had been made during the past year; and he felt that as the Company had earned so much more during this half-year it was time to increase the dividend by what might be considered a fair amount, say to 6 per cent. They could well afford it. It would take only some £18,000, leaving £9,000 to be carried to the reserve. Taking into consideration the nature of the property and the very great risk the shareholders ran, he thought they should receive a higher dividend than 5 per cent. (Hear, hear.) He would therefore move that the matter of the dividend be referred back to the consideration of the directors, with a view to increasing the amount to 6 per cent. (Hear, hear.) He would also point out that the reserve fund was not £157,000, but £314,000, because a part of the latter sum had been invested in their duplicate cable. Therefore the Company stood very much better than appeared by the accounts. Mr. M'Laren Smith seconded the amendment, and remarked that he did not think that if it were carried it would at all alter the Company's prospects of obtaining a steady dividend. Mr. Newton, with reference to the question of proxies, complained that they were generally sent in in the most perfunctory manner, and he argued that therefore proxies were no criterion of the general desire for an increase of the dividend. Mr. Newton went on to say that he could not support the amendment because it was illegal, because of the articles of association, which he considered one of the most infamous documents ever proposed to a body of shareholders. (Hear, hear.) They were really a disgrace to an honourable board of directors. He objected to the resolution from the chair being backed with reference to proxies and to articles of association. It was his interest that only 5 per cent. should be paid. He had only a small interest in the shares, but both himself and his friends had considerable interest in the debentures. He protested against the reserve fund being only £150,000, and urged that it should be stated in full so that the shareholders might know what they would get. In a period of prosperity like the present, when the earnings were 2½ per cent. in excess of revenue, the shareholders should certainly participate to some extent. (Hear, hear.) Mr.

Griffith said that the chairman had recommended stability, but had he considered whether unity was not better? Mr. Marcus suggested that the accounts for 1879 should be passed, and that the shareholders should then recommend the directors in the ensuing quarter or the ensuing year to pay the increased dividend if the prospects of the Company would permit of it. The Chairman: The directors are just as anxious to have harmony and unity betwixt themselves and the general body of the shareholders as the shareholders can be. At the same time we are in a better position to judge as to what is the policy in the interests of the great body of the shareholders. We have no personal interests to serve for ourselves; we have to look to the interests of the shareholders as a body. Now, just think for one moment, gentlemen, we have got 3,000 shareholders, but how many are represented at this meeting to-day? I do not suppose there are more than sixty people in this room. The interest of the few gentlemen who have spoken in this concern is insignificant. Mr. Marcus: I hold three hundred shares. Mr. M'Laren Smith: I hold ten thousand. A Shareholder: This is foreign to the question altogether. The Chairman: The great majority of the shareholders approve of our policy, and we are bound to carry out that policy. Mr. Newton has made some rather strong remarks as to the articles of association. He knows perfectly well what the articles of association have been from the beginning. He has made remarks which I am perfectly sure, when they are reported and when they come to the ears of the large body of the shareholders, they will decide that they are not prepared to leave their interests in Mr. Newton's hands. As to Mr. Griffith, he has made a very quiet statement, as he always does on these occasions, but I think that Mr. Griffith is not sufficiently careful. I do not think that Mr. Griffith has looked at both sides of the report. I do not suppose Mr. Griffith thinks that because we have ships they can be used to supply a new cable. They are a part of the plant necessary to the carrying on of an important work. Mr. Griffith must be perfectly aware that the only sum of money we have to deal with on the occasion of any breakage taking place is the amount of money which we have there in securities, which may be converted into money at the moment. The cable may be in perfect working order, as I have said, to-day: our affairs never looked brighter than they are to-day; but to-morrow the cable may be broken, and it may cost a large sum of money to put it in order. I have told you, in order that you may judge fairly, that since the beginning of this Company we have paid £250,000 in repairs. It is a great uncertainty. Surely we should be wrong, as prudent men, not to keep sufficient money under our control to enable us to make these repairs. I think, gentlemen, that what we have put before you is not unreasonable. As to the suggestion made by Mr. Marcus, I am quite prepared when I return to our board to discuss this question. We have got a certain expression of opinion here to-day, but I am bound to say that the expression of opinion is only from such a very small portion of the shareholders that we should require to get a much larger expression of opinion before we could be induced to change our policy. A Shareholder: For shame! I am surprised. Another Shareholder: We are a representative body here. The Chairman: With these few remarks I will now put the resolution to the meeting. A Shareholder: I think the amendment should be put to the meeting first. The Chairman said that the amendment could not be put as was no: in accordan ce with the articles of association. Mr. Newton: I put it as a recommendation. I should like to hear the article read, if the solicitor will kindly read it. The Solicitor: The article is this: "No larger dividend shall be paid than is recommended by the board." Mr. Marshall: It is a recommendation to this meeting. Mr. Newton: It cannot alter the vote we give to pass a recommendation. Mr. Marshall: I am legally advised, Mr. Chairman, that I can move an amendment to the resolution. The Chairman said that if the Company wanted any alteration they must take steps before the meeting and then they would be in order. He could not rule the meeting in order when it was out of order. If there was anything they objected to they must take their preparation before the meeting. Mr. Newton asked what shareholder would spend the money necessary. He had intended doing so at one time, but he found it would cost £50 to alter the articles of association. He stated at the time, and published the statement in the *Times* with his name at the foot of it, that the directors had blockaded themselves behind the articles of association, which were not right and fair to the Company. It was not right to ask the shareholders to spend £50 to gain an expression of opinion at this meeting. Mr. M'Laren Smith: I do not see what the meeting was called for if we cannot pass any amendment. The Chairman: Gentlemen, I am sorry that any discussion should take place on this matter. I think you are injuring your property, that is all I can say about it. You must pass this resolution; that connot be altered; then if any gentleman desires to move a recommendation to the directors that an increased dividend should be paid at a future time there is no harm in that. The resolution was then put and carried unanimously. Mr. Marshall subsequently moved that the directors take into consideration the traffic receipts from to time, with a view of increasing the dividend. The Chairman: We have no objection whatever to that recommendation being moved and seconded; none whatever. The motion was seconded by Mr. Newton and Mr. M'Laren Smith, and adopted. The Chairman said that no one would rejoice more than he would to see the dividends increased, but he would rejoice still more to see that increase resting upon a basis which would prove permanent. Mr. Bevan and Mr. Earle were re-elected directors. Mr. Baynes called attention to the fact that Baron d'Erlanger had retired from the directorship, and asked whether that would alter the remuneration the board received. The Chairman said that on a previous occasion there was an expression of opinion that there were more directors than were necessary. He then stated that whenever there was an opportunity for a director to retire the board would avail themselves of that opportunity to reduce the amount of remuneration by the amount that the director received. (Hear, hear.) A vote of thanks to the chairman brought the proceedings to a close.

AT a meeting of the Directors of the West India and Panama Telegraph Company, held on April 14th, after deciding to place £2,000 to reserve it was resolved to recommend to the shareholders at the approaching meeting that a dividend at the rate of 6 per cent. per annum be declared on the first and second preference shares for the half-year ending 31st December last, carrying £1,017 to the current year.

THE SUBMARINE CABLES TRUST announce that the coupons which become due on 15th instant, will, under authority of the Court of Chancery, be paid on that date by Messrs. Glyn, Mills, and Co., of Lombard Street. At the last annual meeting a resolution was passed authorising the formation of a limited liability company to take over the property of the trust and carry out its objects. On preparing the articles of association of the proposed new company so many legal difficulties presented themselves, that finding

these insurmountable the trustees abandoned the idea, and having been advised that there was a reasonable probability of the decision of the Master of the Rolls being reversed on appeal, they authorised the necessary steps to be taken to this end. The trustees regret that the large number of cases on record having a prior right to adjudication in the Court of Appeal will involve considerable delay, but they have directed every effort to be made to expedite the hearing.

THE Directors of the Direct United States Cable Company, Limited, have resolved upon the payment of an interim dividend of five shillings per share, being at the rate of 5 per cent. per annum for the quarter ending 31st March, 1880, such dividend to be payable on and after the 15th May next.

Mr. H. WEAVER, the Managing Director of the Anglo-American Telegraph Company, informs us that their cable broken off the coast of Ireland on the 2nd inst. was repaired on the evening of the 15th, and is now in perfect working order and condition.

IT is announced by the Telegraph Construction and Maintenance Company that the tenth distribution, at the rate of 2s. 3d. per £5 certificate of the Second Bonus Trust, will be paid on the 1st of May.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY, LIMITED.—Report of the directors to be presented to the thirteenth half-yearly general meeting, for the half-year ended 31st December, 1879, states that the revenue for this period amounted to £77,504 15s. 8d.; the working expenses to £11,494 5s. 2d., leaving a balance of £66,010 10s. 6d.; to this is added £1,600 4s. 7d., brought forward from the 30th June, 1879, making a total of £67,610 15s. 1d. After deducting income tax, £889 2s. 2d., there remains a balance of £66,721 12s. 11d. First and second interim dividends amounting to £32,500 have been distributed, leaving the sum of £34,221 12s. 11d. to be carried forward. The Company's cables continue in good working order. The shareholders are aware that for some time past the directors have been endeavouring to obtain certain variations of the working agreement with the Western and Brazilian Telegraph Company, the main point being an alteration of the proportions of gross receipts exchanged between the two companies. The board were advised by eminent counsel that this matter was within the powers of the arbitrator to be appointed under the agreement, but the Western and Brazilian Company disputed the claim, and the question has now been decided by the Queen's Bench Division of the High Court of Justice and by the Court of Appeal in favour of the Western and Brazilian Company. Two other of the claims of this company have been assented to, and the Court has appointed an arbitrator to decide upon the only remaining question. It is probable, however, that an arrangement will be come to on this head, and the expense of arbitration avoided. The summary of total traffic receipts shows that for the year 1874-5, they were £128,461; 1875-6, £129,038; 1876-7, £131,507; 1877-8, £134,003; 1878-9, £139,654, and for six months ending 1879, £77,177.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 60¾-61¼; Ditto, Preferred, 89½-90½; Ditto, Deferred, 34-34½; Brazilian Submarine, Limited, 7¾-8; Cuba, Limited, 9¾-10¼; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10½-11; Direct United States Cable, Limited, 1877, 11⅜-11½; Scrip of Debentures, 100-102; Ditto, £25 paid, par-2 pm.; Eastern, Limited, 8¾-9; Eastern 6 per cent. Preference, 12¼-12½; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-105; Eastern 5 per cent. Debentures, repayable August, 1887, 102-104; Eastern, 5 per cent., repayable Aug., 1899, 102-104; Eastern Extension, Australasian and China, Limited, 8¾-9½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 101-103; Ditto, registered, repayable 1900, 102-105; German Union Telegraph and Trust, 8¾-9¼; Globe Telegraph and Trust, Limited, 5¾-6; Globe, 6 per cent. Preference, 11¼-11½; Great Northern, 9¾-10¼; Indo-European, Limited, 24-25; London Platino-Brazilian, Limited, 6-6½; Mediterranean Extension, Limited, 3-3½; Mediterranean Extension, 8 per cent. Preference, 10¼-11¼; Reuter's Limited, 10-11; Submarine, 230-240; Submarine Scrip, 2-2½; West Coast of America, Limited, 2-2½; West India and Panama, Limited, 1½-2½; Ditto, 6 per cent. First Preference, 7¾-8¼; Ditto, ditto, Second Preference, 7-7½; Western and Brazilian, Limited, 8-8¼; Ditto, 6 per cent. Debentures "A," 100-103, Ditto, ditto, ditto, "B," 100-103; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 102-104; Telegraph Construction and Maintenance, Limited, 33¼-34¼; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Co., 14½-15; Ditto, 6 per cent. Debenture, 103-105.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £495,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
March, 1880 ...	*	13,279	3,500	... ...	*	43,374	26,425	16,440	... ...	*	1,775	11,491	6,075
March, 1879 ...	47,550	13,052	3,256	929	15,850	41,255	26,185	15,401	... ...	9,790	3,700	11,683	5,231
Increase	... ...	227	244	... ...	... ...	2,119	240	1,039	... ...	... ...	... ...	... ...	844
Decrease	... ...	... ..	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	1,925	197	... ...

* Publication of receipts temporarily suspended.